



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/613,694	07/03/2003	Yang-Tung Fan	TS00-776B	7190
8933	7590	12/17/2004	EXAMINER	
DUANE MORRIS, LLP IP DEPARTMENT ONE LIBERTY PLACE PHILADELPHIA, PA 19103-7396			TRINH, MICHAEL MANH	
			ART UNIT	PAPER NUMBER
			2822	

DATE MAILED: 12/17/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/613,694

Applicant(s)

FAN ET AL.

Examiner

Michael Trinh

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 September 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 27-41 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) _____ is/are rejected.
- 7) ☒ Claim(s) 27-41 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

Art Unit: 2822

DETAILED ACTION

*** This office action is in response to Applicant's amendment filed on September 17, 2004.

Claims 27-41 are pending. Claims 1-26 were canceled.

*** The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Objections

1. Claim 1 is objected as "said substrate" (at line 3) should be --a substrate--, as there is no previous mentioned of the substrate. Correction is required.

Claim Rejections - 35 USC § 103

2. Claims 27-28,30-38,40-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Greer (6,451,681) taken with Scholz (5,329,423).

Greer '681 teaches at least one solder bump having been created over the surface of a semiconductor substrate 100 comprising: at least one contact pad (202 in Fig 3; 124 in Fig 6) having been provided on the surface of said substrate; a layer of passivation 300,500 (Figs 3,6) having been deposited over the surface of said substrate, said layer of passivation having been patterned and etched creating at least one opening (Figs 3,6; cols 3-6) through said layer of passivation that aligns with said at least one contact pad 202,124 created on the surface of said substrate, exposing the surface of said at least one contact pad 202,124, said layer of passivation 300 having an exposed surface; at least one patterned and etched layer of seed material (e.g. 304 in Fig 3, col 4, lines 16-58; 504/506 in Fig 6, col 5, line 38 through col 6) deposited over the surface of said layer of passivation 300/500, including the exposed surface of said at least one contact pad, said at least one layer of seed material being aligned with said at least one contact pad 202/124; at least one patterned and etched layer (e.g. 308/306 in Fig 3; 604/602/600 in Fig 6) of Under Bump Metal (UBM) created over the surface of said layer 304 of seed material, said at least one layer of UBM being aligned with said at least one layer 304 of seed material; at least one layer (310 in Figs 3; 606 in Fig 6) of solder material having a solder height provided over the surface of said at least one layer of UBM, said at least one layer of solder being aligned with said at least one layer of UBM; a layer (302 in Fig 3, col 4, lines 30-35; 502 in Fig 6; col 5, lines 56-59) of polyimide coated over the exposed surface of the layer 300/500 of passivation to a polyimide

Art Unit: 2822

thickness (re claims 33,37), said polyimide 302/502 thickness being less than said solder 310/606 height by a measurable amount, said solder 310/606 protruding from the surface of said layer of polyimide by said measurable amount, said protrusion forming a protruding layer of solder; said protruding layer of solder having been reflowed, thereby having created a solder ball (Figs 3,6; col 4, lines 59-67). Re claims 28,38 wherein at least one contact pad layer 202 comprises aluminum or aluminum alloy (col 3, lines 60-63). Re claim 30, wherein the at least one layer of Under Bump Metal (UBM) comprises a layer of chrome, followed by a layer of copper, followed by a layer of gold, created to a total thickness of the layers up to 1.94 micron (Fig 3, col 4, lines 44-58, wherein $500\text{nm}+1300\text{nm}+140\text{nm} = 1940\text{ nm} = 1.94\text{ micron}$; and Fig 6, col 6, lines 5-25). Re claims 31,40 wherein the at least one layer of Under Bump Metal (UBM) comprising multiple layers of metal (e.g. 604/602/600 in Fig 6; 308/306 in Fig 3). Re claims 35-36 for etching the polymer layer, and claim 34 for a function of thickness and control the thickness of the polymer layer controls the diameter of the solder ball, a claim is directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See also *In re Brown*, 173 USPQ 685; *In re Luck*, 177 USPQ 523; *In re Fessmann*, 180 USPQ 324; *In re Avery*, 186 USPQ 161; *In re Wertheim*, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); *In re Marosi et al*, 218 USPQ 289; and particularly *In re Thorpe*, 227 USPQ 964, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not.

Re base claims 27 and 34, Greer already teaches a structure having the polymer 302/502 not contacting the solder material 310,606, and thus lacks having the polymer contacting the solder material over a substantial portion of the polymer.

However, Scholz teaches two embodiments of either having the polymer 20 of polyimide contacting the solder material 24,26 over substantial portion of the polymer 20 (Fig 1; col 1, line 35 through col 4), or having the polymer 20 not contacting the solder material 24,26 (Fig 3; col 5, lines 34-65).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the structure of Greer by forming an semiconductor

structure having the polymer 20 contacting the solder material 24,26 over substantial portion of the polymer as alternatively taught by Scholz. This is because of the desirability to form another alternative semiconductor structure having the polymer contacting the solder material over substantial portion of the polymer, wherein the bottom of the solder material is completely protected and covered by the polymer.

3. Claims 27-28,31,33-38,40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuboi (6,528,881) taken with Scholz (5,329,423).

Tsuboi teaches at least one solder bump having been created over the surface of a semiconductor substrate 11 comprising: at least one contact pad (15, col 4, lines 13-44; Figs 2,18,11-16; col 7, line 60 through col 9) having been provided on the surface of said substrate; a layer of passivation 13 (Figs 2,18) having been deposited over the surface of said substrate, said layer 13 of passivation having been patterned and etched creating at least one opening (Figs 2,12) through said layer of passivation that aligns with said at least one contact pad 15 created on the surface of said substrate, exposing the surface of said at least one contact pad 15 said layer of passivation 13 having an exposed surface; at least one patterned and etched layer 18 (Fig 3, col 4, lines 45-60; and Figs 13,18; col 8, lines 11-65) of barrier seed material deposited over the surface of said layer 13 of passivation (Fig 18), including the exposed surface of said at least one contact pad 15, said at least one layer of seed material being aligned with said at least one contact pad 15; at least one patterned and etched layer 19 (Figs 3,18) of Under Bump Metal (UBM) created over the surface of said layer 18 of barrier seed material, said least one layer 19 of UBM being aligned with said at least one layer 18 of seed material; at least on layer 24 of solder material (Fig 5, col 8, lines 64-67; Fig 18) having a solder height provided over the surface of said at least one layer of UBM, said least one layer 24 of solder being aligned with said at least one layer of UBM; a layer of polyimide (Fig 18,5,2; col 9, lines 50-55; col 4, lines 32-43) coated over the exposed surface of the layer 13 of passivation to a polyimide thickness (re claims 33,37), said polyimide thickness being less than said solder 24 height by a measurable amount, said solder 24 protruding from the surface of said layer of polyimide by said measurable amount, said protrusion forming a protruding layer of solder; said protruding layer of solder having been reflowed, thereby having created a solder ball (col 8, lines 64-67; Figs 18,5). Re

Art Unit: 2822

claims 28 and 38, wherein at least one contact pad layer 15 comprises aluminum or aluminum alloy (col 4, lines 13-20). Re claims 31 and 40, wherein the at least one layer of Under Bump Metal (UBM) comprising multiple layers of metal comprising two metal layers under the solder bump 24 (col 9, lines 62 through col 10 for a copper layer 19 and a nickel layer). Re claims 35-36 for etching the polymer layer, and claim 34 for a function of thickness and control the thickness of the polymer layer controls the diameter of the solder ball, a claim is directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See also *In re Brown*, 173 USPQ 685; *In re Luck*, 177 USPQ 523; *In re Fessmann*, 180 USPQ 324; *In re Avery*, 186 USPQ 161; *In re Wertheim*, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); *In re Marosi et al*, 218 USPQ 289; and particularly *In re Thorpe*, 227 USPQ 964, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not.

Tsuboi already teaches (at Figure 18 a structure having a portion of the polymer 23 contacting the solder material, but lacks having the polymer contacting the solder material over a substantial portion of the polymer.

However, Scholz teaches two embodiments of either having the polymer 20 of polyimide contacting the solder material 24,26 over substantial portion of the polymer 20 (Fig 1; col 1, line 35 through col 4), or having the polymer 20 not contacting the solder material 24,26 (Fig 3; col 5, lines 34-65).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the structure of Greer by forming an semiconductor structure having the polymer 20 contacting the solder material 24,26 over substantial portion of the polymer as alternatively taught by Scholz. This is because of the desirability to form another alternative semiconductor structure having the polymer contacting the solder material over substantial portion of the polymer, wherein the bottom of the solder material is completely protected and covered by the polymer.

Art Unit: 2822

4. Claims 29,39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Greer (6,451,681) and Scholz (5,329,423), as applied to claims 27-28,30-38,40-41, and further of Moyer et al (6,620,720).

Greer '681 and Scholz teach at least one solder bump having been created over the surface of a semiconductor substrate as applied to claims 27-28 and 30-38,40-41 above. Re claims 29 and 39, Greer also teaches (at col 4, lines 44-58) forming at least one of the under bump metal layers comprising a layer of nickel.

Greer '681 thus already teaches a layer of nickel, but lacks providing a thickness between about 1 and 10 micron.

However, Greer '681 also teaches (at col 4, lines 44-58) creating a thickness of the under-bump metal layers up to 1.94 micron ($500\text{nm} + 1300\text{nm} + 140\text{nm} = 1940\text{ nm} = 1.94\text{ micron}$). Moyer teaches (at col 3, lines 20-56; Figs 2-6B; col 4) forming a solder bump with at least one of the under bump metal layers comprising a layer of nickel, created to a thickness in the range 2000-20000 micron (.2 to 20 micron).

Therefore, the subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to select the portion of the prior art's range of thickness, as taught by Greer '681 and Moyer, which is within and encompassing the range of applicant's claims, because it has been held to be obvious to select a value in a known range by optimization for the best results, see *In re Aller*, et al., 105 USPQ 233; *In re Waite* 77 USPQ 586 (CCPA 1948); *In Re Swanson* 56 USPQ 372 (CCPA 1942).

Response to Arguments

5. Applicant's remarks filed September 17, 2004, about the references lack having the polymer contact the solder material over substantial portion of the polymer, have been fully considered but they are not persuasive, and are also moot in view of the new ground(s) of rejection, in which, Scholz (5,329,423) teaches two embodiments of either having the polymer 20 of polyimide contacting the solder material 24,26 over substantial portion of the polymer 20 (Fig 1; col 1, line 35 through col 4), or having the polymer 20 not contacting the solder material 24,26 (Fig 3; col 5, lines 34-65).

Art Unit: 2822

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael M. Trinh whose telephone number is (571) 272-1847. The examiner can normally be reached on M-F from 8:30 Am to 4:30 Pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Oacs-8



Michael Trinh
Primary Examiner